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EFFECT OF HEAVY METAL ON AQUATIC ALGAE AND INFLUENCE OF ERMIWASH ON ALGAL GROWTH

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ABSTRACT

Unicellular algae, at the base of most aquatic food chains, are particularly sensitive to a wide range of pollutants and are therefore an important part of a battery of toxicity tests for hazard assessment and aquatic environment protection. The use of bioassays for toxicity assessment, based on growth inhibition in algae is described and effect of vermiwash on algal growth is also observed. To overcome the toxic effect of metal use vermiwash, an organic liquid fertilizer. Vermiwash plays an important role in the plant growth and development. The interactive effect of metal ions namely Copper, chromium and Lead has been studied under controlled conditions on the photosynthetic green alga Scenedesmus bijugates over the exponential growth. In the present work describes algal growth is decreases if the metal ion concentration increase and reverse result found in case of vermiwash.

Keywords: Algae, Heavy metal, Vermiwash

INTRODUCTION

The concentration of heavy metals (Cd, Cu, Zn, Pb, Co, Hg) in the environment is increasing continuously as a consequence of the increased environmental pollution from industrial, agricultural, energetic and municipal sources (Adrino, 1986). However few metals e.g., Cu, Zn, Co, Fe in trace amounts are essential for various metabolic activities of plants. But excess of all kinds of metals (essential and non-essential both) adversely affect the plant metabolism (Hall, 2002). In plants, metals exert their toxic action mostly by

damaging chloroplast and disturbing photosynthesis

Unlike many other pollutants in the environment, heavy metals are non biodegradable (Kaewsarn and Yu, 2001). Remediation processes for heavy metal-polluted ecosystems are difficult, and expensive. Heavy metals can also be accumulated by some organisms either directly (e.g., in the case of macroalgae) or through the food chain, eventually posing a serious health risk to inhabitants of an ecosystem, including humans (Galloway et al., 1982; Angelone and Bini 1992; Chan et al., 2003). The bioaccumulation of toxicants, such as heavy metals, by living organisms is often a good integrative indicator of exposure, and has been extensively used to assess contamination levels of heavy metals in polluted ecosystems (Phillips and Rainbow, 1994). Algae are major primary producers in the aquatic environment and play an important role in food chains. Since water pollution is most serious. To major water pollution algae are particularly suitable for pollution studies. Selection of sensitive and ecologically-relevant test species is essential.

In case of Vermiwash liquid fertilizer contains N, P, K, Ca and hormones such as auxin, cytokinine, some other secretions act as a readily available nutrient to the plants as fertilizer. Vermiwash plays an important role in the plant growth and development. In the above experiment toxic effect of heavy metal on algae and effect of vermiwash for algal growth has been studied.

MATERIAL AND METHOD

The five day conventional algal bioassay test is carried out to assay the toxicity of heavy metal. The toxicity response of alga towards copper, lead and Cromium to access LC 50 or EC50 concentration. Most algal bioassays are growth inhibition tests, which measure the decrease in growth rate (cell division rate) or final cell biomass. Algae *Scenedesmus bijugatus* is selected on the basis of its well established characteristics, morphology and physiology, simple culture conditions, fast growth and sensitivity to pollutants and it is very commonly found in fresh water bodies throughout India. Incubated under controlled light and temperature conditions. The algal test was carried out for 96 hrs.

Chu 10 medium is used for the growth of green algae. This is autoclaved at 15 lbs for 15 min. The test chemical should be dissolved in a suitable solvent or prepared as a suspension or emulsion in distilled water in different concentrations equivalent to 3mg/l, 4mg/l, 2mg/l. Algal growth is usually estimated daily by optical density using spectrophotometer.

25 ml culture medium with hand without amendments is taken in 100 ml Erlenmeyer flasks, plugged with cotton wool and autoclaved 1 ml of 1 week old dilute stock culture (approximately 1.0 x 106cells/ml) is used as inoculums. The biomass (O.D) of the stock culture is determined at the start of the experiment to know the initial value. Mild shaking of the test cultures is required for 5-10 min each day.

AGP test using vermiwash: Vermiwash is the collection of excretory products and excess secretions of earthworms along with micronutrients from soil organic molecules. It is a liquid fertilizer and it is used as a foliar spray. Earthworms with

compost were the raw materials for the preparation of vermiwash Cow dung and leaf litter were dried under shade and broken to small pieces. The substrates were mixed in the ratio of 1: 1. Required amount of water was added to the mixer to hold 70 – 80% moisture. This mixer was pre- decomposed for 10 days and filled in a cement tank having proper drainage facilities. The unit was kept in shade. Sufficient moisture level was maintained by sprinkling water, within one month the earthworms started to multiply. These worms were used for the vermisubstrate prepared by using cowdung and leaf litter in the ratio of 1: 1. The prepared vermiwash was collected and diluted in 1 %, 5%, 10% dilution and used for said experiment. The growth of algae was observed in spectrophotometer.

RESULT AND DISCUSSION

Like all living organisms, plants are often sensitive both to the deficiency and to the excess availability of some heavy metal ions as essential micronutrient, while the same at higher concentrations and even more ions such as Cd, Hg, as are strongly poisonous to the metabolic activities. Researchers have been conducted throughout the world to determine the effects of toxic heavy metals on plants (Reeves and Baker 2000; Fernandes and Henriques 1991). Heavy metals directly affect the photosynthetic machinery by binding to the various sensitive sites of the photosynthetic apparatus. In chloroplast, heavy metals disturb the architecture of thylakoid membranes, which in turn, change some light reaction processes, directly especially those associated with PSII. Growth-inhibition bioassays using the freshwater green alga *Scenedesmus bijugatus* have been used extensively for assessing a toxicity of heavy metal. The ultimate aim is to determine the toxicity of heavy metal i.e. copper, lead and cromium.

Copper: 0.01 ppm copper was found to be stimulatory for the algal growth and it act as a micro-nutrient at low concentration and plays important role in CO_2 assimilation and ATP synthesis. Cu is also an essential component of various proteins like plastocyanin of photosynthetic system and cytochrome oxidase of respiratory electron transport chain (Demirevska-kepova et al, 2004).

Therefore, copper deficiency reduces PSI electron transport due to decreased formation of plastocyanin (Baszynski et al, 1988). A decrease in PSII is also observed in Cu deficient plants (Henriques, 1989). But enhanced industrial and mining activities have contributed to the increasing occurrence of Cu in ecosystems. Cu is also added to soils from different human activities. 1 ppm and above concentration of copper are lethal i.e. above the 50% toxicity. It is evident that excess Cu has a strong effect on chloroplast fine structure. In fig.1.Showed that percent reduction in algal growth potential LC50 values were estimated to be 0.67ppm on third day, 0.66 ppm on fourth day and 0.64 ppm on fifth day. For the 96-h copper experiment, *C. insidiosum* LC50 values 0.47mg/l (0.33-0.66) also showed the same result (Prato et al, 2006). It showed that the Copper toxicity can interfere with the biosynthesis of the photosynthetic machinery, changing the pigment and protein composition of photosynthetic membranes. A lower content of chlorophyll, inactivation of enzymes and

proteins linked to photosynthesis process and modification of thylakoid membranes occurs under copper toxicity. In present study algae bioassay for heavy metals can detect low level in the environment for ex 0.01 ppm Cu play a micronutrient role in algal growth. Algae respond to increasing levels of heavy metals. As the copper concentration increases growth of algae decreases.

Lead: Lead as a toxicologically relevant element has been brought into the environment by man in extreme amounts, despite its low geochemical mobility and has been distributed worldwide (Oehlenschläger, 2002). Food is one of the major sources of lead exposure; the others are air (mainly lead dust originating from petrol) and drinking water. Plant food may be contaminated with lead through its uptake from ambient air and soil; animals may then ingest the lead contaminated vegetation. In this study Results of conventional algal bioassay with lead (0.01 to 4 ppm) was conducted. However LC50 values are not obtained in this experiment. It showed that the 0.01 ppm to 4 ppm lead were not toxicant to the algae. Therefore next set of experiment was carried out with higher concentrations of lead ranging from (5 ppm to 10 ppm). Fig.2.showed that, LC50 concentration was observed to be 8.47 ppm for third day, 9.73 ppm for fourth day and 11.17ppm for 5th day. Present value is also concur with the 12.11mg/L for unicellular cyanobacterium *Synechocystis sp*. PCC 6803 (Arunakumara, 2008)

Chromium: Chromium (Cr) compounds are highly toxic and are detrimental to growth and development. Chromium toxicity is one of the important factors that affect photosynthesis in terms of CO_2 fixation, electron transport, photophosphorylation and enzyme activities. Results of the algal bioassay with Cromimum concentrations ranging from 0.01ppm to 4ppm. Fig.3. showed that lethal concentrations were observed to be from 1 ppm onwards. LC50 values are 0.73ppm for third day, 0.66ppm on fourth day and 0.62ppm on fifth day. Bringmann and Kühn (1980) found that inhibition of cellular multiplication in Scenedesmus quadricauda began to occur at 0.58 mg/1

From the above mention value of metal show that the copper is more toxicant than cromium followed by lead to algae.

AGP: The aims of this research were to find out the effect of different concentrations (1%, 5% and 10%) of vermiwash on the algal growth parameters of fresh water green algae *Scenedesmus bijugates*. The different concentrations of vermiwash were applied to the algal cultured. Stimulation in all dilutions of vermiwash were observed in fig. 4. Maximum stimulation was observed to be 50.3% in 10% vermiwash dilution followed by 43.7% in 5% vermiwash dilution and 30.7% in 1% vermiwash dilution. In present experimental conditions the composition of calcium, magnesium, zinc, and potassium, which constitutes the main nutrient in vermiwash, all the nutrients presents in vermiwash easily available to algae and algal growth was observed.

CONCLUSION

Algal bioassay is the most commonly used. Algae are considered to be reliable indicators of pollution due to their high sensitivity and easy availability, besides simple culturing technique. Due to

this characteristic the pollution could be measure as early as possible.

Vermiwash used in Organic farming which fulfills the food and nutrition needs of society without depleting the essential natural resources and reduce the use of chemical fertilizers. Vermiwash also helpful in the organic waste management

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Fig. 1: Straight Line Relationship for Percent Reduction in Algal Growth Potential and Indication of LC50 Concentrations in Conventional Algal Bioassay with Copper

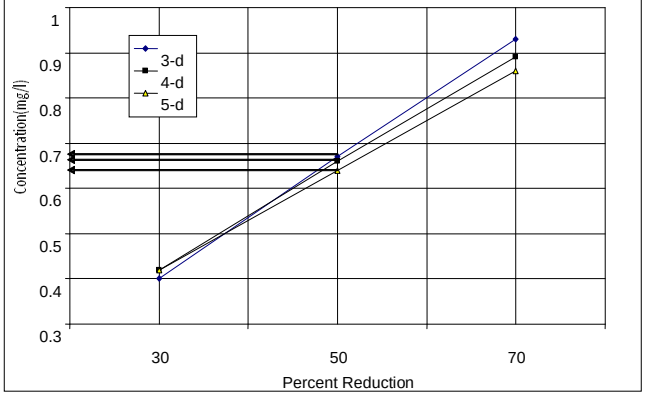

Fig. 2: Straight Line Relationship for Percentage Reduction in Algal Growth Potential and Indication of LC50 Concentrations in Conventional Algal Bioassay with Lead

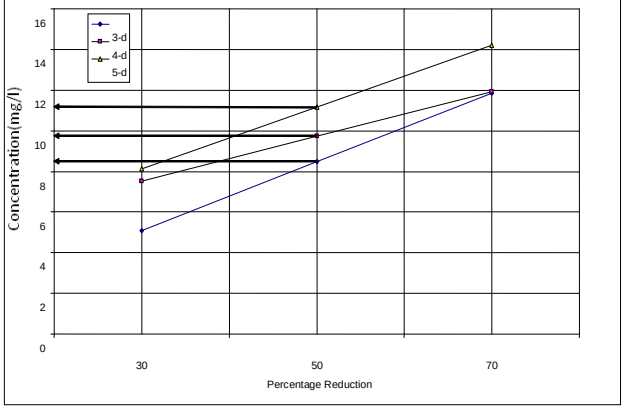

Fig. 3: Straight Line Relationship for Percentage Reduction in Algal Growth Potential and Indication of LC50 Concentrrations in Conventional Algal Bioassay with Cromium

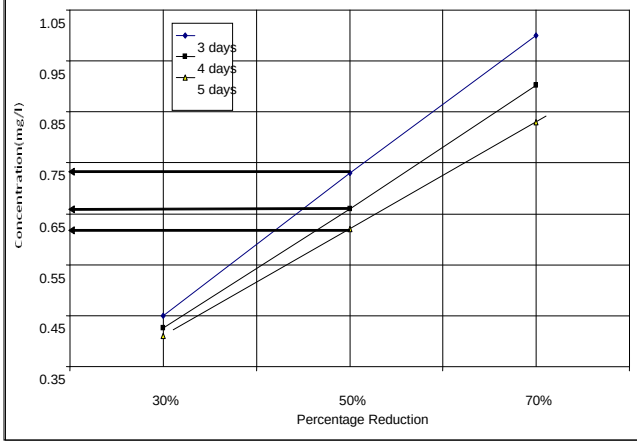

Fig. 4. : Percentage Stimulation in Algal growth Potential in Conventional Five Day Algal Bioassay Test with Cowdung Vermiwash